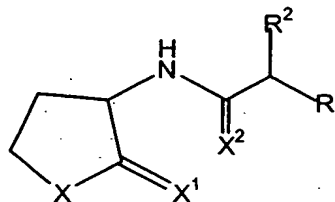


WHAT IS CLAIMED IS:

1. A compound having the structure:



wherein,

R^1 is a member selected from $-H$, $-OH$, and $(=O)$;

R^2 is a member selected from H, reactive functional groups, alkyl groups terminally substituted with a reactive functional group and internally substituted alkyl groups terminally substituted with a reactive functional group;

X is a member selected from $-O-$, $-S-$ and $-NH-$; and

X^1 and X^2 are members independently selected from O and S.

2. The compound according to claim 1, wherein R^2 is an internally substituted alkyl group terminally substituted with a reactive functional group.

3. The compound according to claim 2, wherein the alkyl group is internally substituted with a functional group that is a member selected from $-OH$, $(=O)$ and combinations thereof.

4. The compound according to claim 1, wherein the reactive functional group is a member selected from $-OR^3$, $-NHR^4$, $-COR^5$, $-SH$ and $-CH_2X^3$

wherein,

$-OR^3$ is a member selected from hydroxy, alkyl sulfonate and aryl sulfonate groups;

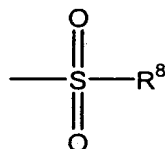
R^4 is a member selected from H, C_1-C_6 alkyl, C_1-C_6 substituted alkyl, aryl and substituted aryl groups;

R^5 is a member selected from H, X^3 and $-OR^6$, wherein R^6 a member selected from alkyl, substituted alkyl, aryl, substituted aryl,

11 heteroaryl, substituted heteroaryl, heterocyclyl and substituted
12 heterocyclyl groups; and
13 X^3 is a halogen.

1 5. The compound according to claim 1, wherein the compound is a
2 single stereoisomer.

1 6. The compound according to claim 4, wherein R^3 is



(V)

2
3 wherein,

4 R^8 is a member selected from alkyl, substituted alkyl, aryl and substituted
5 aryl groups.

1 7. The compound according to claim 1, wherein the alkyl and the
2 internally substituted alkyl groups are members selected from C_1 - C_{20} saturated straight-
3 chain, C_1 - C_{20} saturated branched-chain, C_1 - C_{20} unsaturated straight-chain, C_1 - C_{20}
4 unsaturated branched-chain alkyl and internally substituted alkyl groups.

1 8. The compound according to claim 7, wherein the alkyl and
2 internally substituted alkyl groups are members selected from C_5 - C_{10} saturated straight-
3 chain, C_5 - C_{10} saturated branched-chain, C_5 - C_{10} unsaturated straight-chain, C_5 - C_{10}
4 unsaturated branched-chain alkyl and internally substituted alkyl groups.

1 9. A compound according to claim 1, wherein R^2 has the structure:

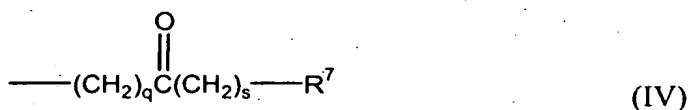


2
3 wherein,

4 R^7 a reactive functional group; and
5 n is a number from 1 to 20, inclusive.

1 10. The compound according to claim 9, wherein n is a number from 2
2 to 9, inclusive.

1 11. A compound according to claim 1, wherein R^2 has the structure:



wherein,

R^7 is a reactive functional group; and

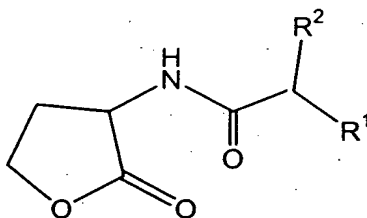
q and s are numbers independently selected from 1 to 20, inclusive.

12. The compound according to claim 11, wherein s is a number from 2 to 9, inclusive.

13. A pharmaceutical formulation comprising a pharmaceutically acceptable carrier and a compound according to claim 1, said reactive functional group of said compound being covalently bound to a biologically active agent.

14. The pharmaceutical formulation according to claim 13, wherein said biologically active agent is a member selected from antibiotics, immune stimulators and combinations thereof.

15. A compound having the structure:



(II)

wherein,

R^1 is a member selected from H, OH, and (=O); and

R^2 is a member selected from H, reactive functional groups, alkyl groups terminally substituted with a reactive functional group and internally substituted alkyl groups terminally substituted with a reactive functional group, with the proviso that when R^2 is ---OH , R^1 is a member selected from OH, and (=O).

16. The compound according to claim 15, wherein the reactive functional group is a member selected from ---OR^3 , ---NHR^4 , ---COR^5 , SH and CH_2X^3 wherein,

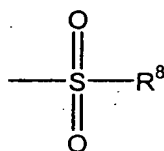
4 —OR³ is a member selected from hydroxy, and a species such that —OR³
5 is a leaving group;

6 R⁴ is a member selected from H, C₁-C₆ alkyl, C₁-C₆ substituted alkyl, aryl
7 and substituted aryl groups;

8 R⁵ is a member selected from H, halogen and —OR⁶, wherein R⁶ is
9 species such that —OR⁶ is a leaving group; and

10 X³ is a halogen.

1 17. The compound according to claim 16, wherein R³ is



2 (V)

3 wherein,

4 R⁸ is a member selected from alkyl, substituted alkyl, aryl and substituted
5 aryl groups.

1 18. The compound according to claim 16, wherein R⁶ is a member
2 selected from alkyl, substituted alkyl, aryl, substituted aryl, heteroaryl, substituted
3 heteroaryl, heterocyclyl and substituted heterocyclyl groups.

1 19. The compound according to claim 15, wherein the alkyl and the
2 internally substituted alkyl groups are members selected from C₁-C₂₀ saturated straight-
3 chain, C₁-C₂₀ saturated branched-chain, C₁-C₂₀ unsaturated straight-chain, C₁-C₂₀
4 unsaturated branched-chain alkyl and internally substituted alkyl groups.

1 20. The compound according to claim 19, wherein the alkyl and
2 internally substituted alkyl groups are members selected from C₅-C₁₀ saturated straight-
3 chain, C₅-C₁₀ saturated branched-chain, C₅-C₁₀ unsaturated straight-chain, C₅-C₁₀
4 unsaturated branched-chain alkyl and internally substituted alkyl groups.

1 21. A compound according to claim 15, wherein R² has the structure:



2 wherein,

3 R⁷ is a reactive functional group; and
4

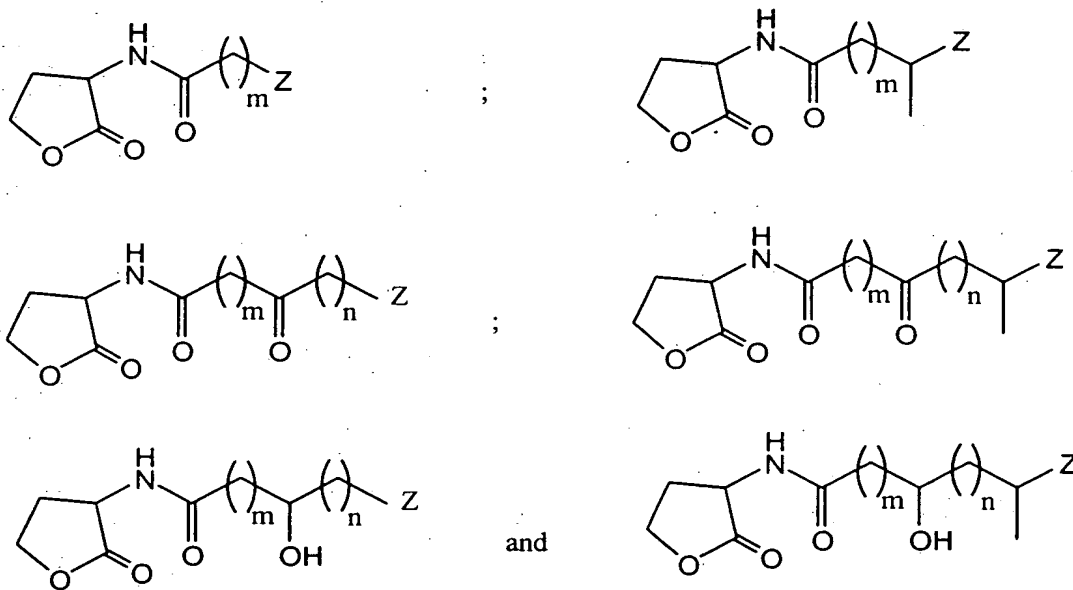
5 n is a number from 1 to 20, inclusive.

1 22. The compound according to claim 21, wherein n is a number from
2 2 to 9, inclusive.

1 23. The compound according to claim 15, wherein R² is a member
2 selected from the group consisting of—COOH, —OH, —NH₂, and —SH.

1 24. The compound according to claim 21, wherein R⁷ is a member
2 selected from the group consisting of—COOH, —OH, —NH₂, and —SH.

1 25. A compound having a structure that is a member selected from:



3 wherein,

4 m is a number selected from 1 to 20, inclusive;

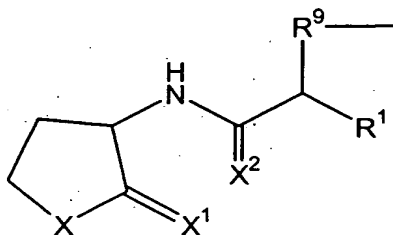
5 n is a number from 0 to 20, inclusive; and

6 Z is a reactive functional group.

1 26. The compound according to claim 25, wherein m and n are
2 numbers independently selected from 2 to 9, inclusive.

1 27. The compound according to claim 25, wherein Z is a member
2 selected from —NH₂, —COOH, —SH, and —OH.

1 28. An immobilized compound comprising a solid support to which is
2 attached a molecule comprising the structure:



(VI)

3
4 wherein,

5 R¹ is a member selected from —H, —OH, and (=O);

6 R⁹ is a member selected from alkyl groups and substituted alkyl groups;

7 X is a member selected from —O—, —S— and —NH—;

8 X¹ and X² are members independently selected from O and S.

1 29. The immobilized compound according to claim 28, wherein the
2 solid support is a member selected from beads, particles, membranes, substantially planar
3 surfaces and combinations thereof.

1 30. The immobilized compound according to claim 28, wherein the
2 solid support comprises a member selected from silica, metal, plastic and combinations
3 thereof

1 31. The immobilized compound according to claim 28, wherein R⁹
2 comprises a spacer moiety situated between the molecule and the solid support.

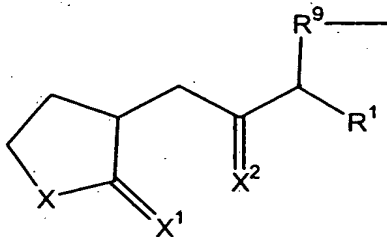
1 32. The immobilized compound according to claim 31, wherein the
2 spacer moiety is selected from C₆-C₃₀ alkyl groups, C₆-C₃₀ substituted alkyl groups,
3 polyols, polyethers, polyamines, polyamino acids, polysaccharides and combinations
4 thereof.

1 33. The immobilized compound according to claim 31, wherein the
2 spacer moiety comprises a cleavable moiety.

1 34. The immobilized compound according to claim 33, wherein the
2 cleavable moiety is cleaved by a member selected from light, heat, oxidation, reduction,
3 enzymatic action, hydrolysis and combinations thereof.

1 35. The immobilized compound according to claim 34, wherein the
2 cleavable moiety is a member selected from disulfides and esters.

1 36. A method for isolating a microbial receptor binding to a molecule
2 comprising the formula:



(VI)

4 wherein,

5 R¹ is a member selected from —H, —OH, and (=O);

6 R⁹ is a member selected from alkyl groups and substituted alkyl groups;

7 X is a member selected from —O—, —S— and —NH—;

8 X¹ and X² are members independently selected from O and S;

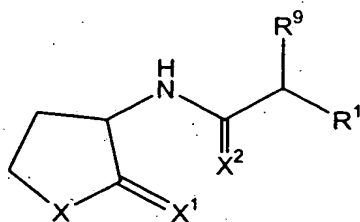
9 the method comprising:

10 contacting a microbial preparation comprising the receptor with the
11 immobilized compound according to claim 28, thereby forming a
12 complex between the receptor and the immobilized compound.

1 37. The method according to claim 36, further comprising separating
2 the complex from components of the microbial preparation not comprising the receptor.

1 38. The method according to claim 37, further comprising disrupting
2 the complex between the immobilized compound and the receptor, thereby separating the
3 receptor from the immobilized compound.

1 39. An immunogenic conjugate comprising a target component
2 comprising the structure:



(IX)

wherein,

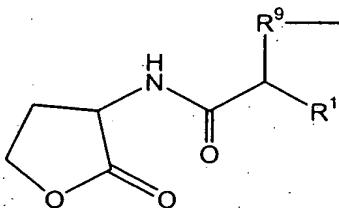
R^1 is a member selected from $-H$, $-OH$, and $(=O)$;

R^9 is a member selected from alkyl groups and substituted alkyl groups;

X is a member selected from $-O-$, $-S-$ and $-NH-$; and

X^1 and X^2 are members independently selected from O and S .

40. The immunogenic conjugate according to claim 39, wherein the target component comprises the structure:



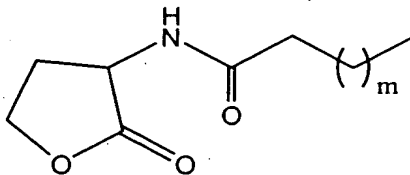
(X)

wherein,

R^1 is a member selected from H , OH , and $(=O)$; and

R^9 is a member selected from alkyl and substituted alkyl groups.

41. The immunogenic conjugate according to claim 40, wherein the target component has the structure:

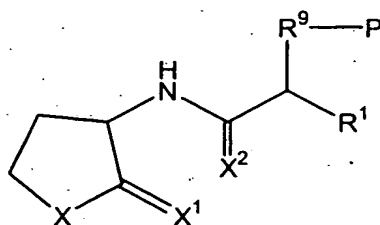


(XI)

wherein,

m is a number from 0 to 30, inclusive.

42. The immunogenic conjugate according to claim 39 having the structure:



wherein,

R¹ is a member selected from —H, —OH, and (=O);

R⁹ is a member selected from alkyl groups and substituted alkyl groups;

X is a member selected from —O—, —S— and —NH—;

X¹ and X² are members independently selected from O and S; and

P is a protein carrier.

43. The immunogenic conjugate according to claim 42, wherein the protein carrier has a molecular weight of greater than or equal to 5000 daltons.

44. The immunogenic conjugate according to claim 43, wherein the protein carrier is a member selected from albumin and hemocyanin.

45. The immunogenic conjugate according to claim 39, wherein R⁹ comprises a spacer moiety situated between the target component and the protein carrier.

46. The immunogenic conjugate according to claim 45, wherein the spacer moiety is selected from C₆-C₃₀ alkyl groups, C₆-C₃₀ substituted alkyl groups, polyols, polyethers, polyamines, polyamino acids, polysaccharides and combinations thereof.

47. The immunogenic conjugate according to claim 45, wherein the spacer moiety comprises a cleavable moiety.

48. The immunogenic conjugate according to claim 47, wherein the cleavable moiety is cleaved by a member selected from light, heat, oxidation, reduction, enzymatic action, hydrolysis and combinations thereof.

49. The immunogenic conjugate according to claim 48, wherein the cleavable moiety is a member selected from disulfides and esters.

1 **50.** A pharmaceutical formulation comprising the immunogenic
2 conjugate according to claim 39 and a pharmaceutically acceptable carrier.

1 **51.** The pharmaceutical formulation according to claim 50, wherein the
2 pharmaceutical formulation is a vaccine effective for preventing or reducing microbial
3 infection in a subject to whom the vaccine is administered.

1 **52.** An antibody that binds specifically to the immunogenic conjugate
2 according to claim 39.

1 **53.** An isolated nucleic acid encoding the antibody according to claim
2 52.

1 **54.** The isolated nucleic acid according to claim 53, further comprising
2 a promoter operably linked to the nucleic acid sequence encoding the antibody.

1 **55.** An expression vector comprising the nucleic acid according to
2 claim 53.

1 **56.** A host cell comprising the expression vector according to claim 55.

1 **57.** The antibody according to claim 52, further comprising a member
2 selected from detectable labels, biologically active agents and combinations thereof
3 covalently attached to the antibody.

1 **58.** The antibody according to claim 57, wherein the detectable label is
2 a member selected from the group consisting of radioactive isotopes, fluorescent agents,
3 fluorescent agent precursors, chromophores, enzymes and combinations thereof.

1 **59.** The antibody according to claim 58, wherein the biologically active
2 agent is a member selected from antibiotics, immune stimulators and combinations
3 thereof.

1 **60.** A pharmaceutical formulation comprising the antibody according
2 to claim 52 and a pharmaceutically acceptable carrier.

1 **61.** A method for treating or preventing a disease in a subject caused
2 by a microorganism, the method comprising administering to the subject an amount of the
3 antibody according to claim **52** effective to reduce or prevent the disease state.

1 **62.** A method for treating or preventing a disease in a subject caused
2 by a microorganism, the method comprising administering to the subject an amount of the
3 vaccine according to claim **51** effective to reduce or prevent the disease state.

1 **63.** A method for treating or preventing a disease in a subject caused
2 by a microorganism, the method comprising administering to the subject an amount of the
3 immunogenic conjugate according to claim **39** effective to reduce or prevent the disease
4 state.

1 **64.** The method according to claim **61**, wherein the disease is a
2 microbial infection.

1 **65.** The method according to claim **62**, wherein said microbial
2 infection accompanies cystic fibrosis.

1 **66.** The method according to claim **74**, wherein said microbial
2 infection has a causative agent comprising *P. aeruginosa*.

1 **67.** A method for preventing or disrupting the formation of a biofilm,
2 the method comprising contacting a microbial culture capable of forming a biofilm with
3 an antibody according to claim **52**.

1 **68.** The method according to claim **67**, wherein said biofilm comprises
2 *P. aeruginosa*.

1 **69.** The method according to claim **67**, wherein said biofilm is
2 associated with an implanted medical device.

1 **70.** The method according to claim **67**, wherein said biofilm is
2 associated with an organ *in vivo*.

1 71. A method for controlling autoinducer responsive gene expression
2 in a microorganism, the method comprising contacting the microorganism with an
3 antibody according to claim 52 effective to control said gene expression.

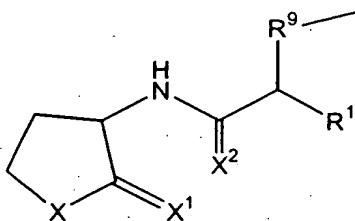
1 72. A method for controlling autoinducer responsive gene expression
2 in a microorganism, the method comprising contacting the microorganism with an
3 antibody according to claim 51 effective to control said gene expression.

1 73. A method for controlling autoinducer responsive gene expression
2 in a microorganism, the method comprising contacting the microorganism with an
3 antibody according to claim 39 effective to control said gene expression.

1 74. The method according to claim 71, wherein the microorganism is
2 bacteria.

1 75. The method according to claim 74, wherein said bacteria is *P.*
2 *aeruginosa*.

1 76. A library of compounds comprising a structure according to
2 Formula I:



(IX)

4 wherein,

5 R¹ is a member selected from —H, —OH, and (=O);

6 R⁹ is a member selected from alkyl groups and substituted alkyl groups;

7 X is a member selected from —O—, —S— and —NH—;

8 X¹ and X² are members independently selected from O and S, the library

9 comprising a first compound according to Formula I and a second compound according to
10 Formula I, wherein the first compound differs from the second compound in the identity
11 of a member selected from R¹, R⁹, X, X¹, X and combinations thereof.

- 1 77. The library according to claim 76, comprising at least 10
2 compounds.
- 1 78. The library according to claim 77, comprising at least 100
2 compounds..
- 1 79. The library according to claim 78 comprising at least 1000
2 compounds..
- 1 80. The library according to claim 79 comprising at least 100,000
2 compounds.
- 1 81. A method of detecting an autoinducer in a sample, the method
2 comprising the steps of:
3 (a) contacting the sample with an antibody that specifically binds to the
4 autoinducer; and
5 (b) determining whether the sample contains the autoinducer, thereby
6 detecting said autoinducer.
- 1 82. The method of claim 81, wherein the antibody is a monoclonal
2 antibody.
- 1 83. The method of claim 81, wherein the antibody is a polyclonal
2 antibody.
- 1 84. The method of claim 81, wherein the step of determining whether
2 the sample contains an autoinducer comprises detecting the antibody in an assay selected
3 from the group consisting of an ELISA assay, a western blot, an immunohistochemical
4 assay, an immunofluorescence assay, and a real time imaging assay.
- 1 85. The method of claim 81, wherein the step of determining whether
2 the sample contains an autoinducer further comprises quantitating the amount of
3 autoinducer in the sample.
- 1 86. The method of claim 81, wherein the antibody is bound to a solid
2 substrate.

1 **87.** The method of claim **81**, wherein the sample is selected from the
2 group consisting of a cultured cell, and a patient sample.

1 **88.** The method of claim **87**, wherein the patient sample is a blood
2 sample.

1 **89.** The method of claim **87**, wherein the patient sample is from a
2 human patient.

1 **90.** The method of claim **81**, wherein the antibody is covalently linked
2 to a detectable moiety.

1 **91.** The method of claim **90**, wherein the antibody is covalently linked
2 to a member selected from a biotin moiety, a radioactive moiety, an enzyme moiety and
3 combinations thereof.

1 **92.** A method of monitoring the amount of autoinducer in a patient
2 treated with an agent that inhibits the growth of an organism producing the autoinducer,
3 the method comprising:

4 (a) providing a sample from the patient treated with the growth inhibiting
5 agent;

6 (b) contacting the sample with an antibody that specifically binds to an
7 autoinducer; and

8 (c) determining the amount of autoinducer in the patient sample by
9 detecting the antibody and comparing the amount of antibody
10 detected in the patient sample to a standard curve, thereby
11 monitoring the amount of autoinducer in the patient.

1 **93.** The method of claim **92**, further comprising the step of adjusting
2 the dose of the growth inhibiting agent administered to the patient.

1 **94.** The method of claim **92**, wherein the sample is a blood sample.

1 **95.** The method according to claim **94**, wherein said blood sample is
2 derived from a patient having cystic fibrosis and an infection comprising *P. aeruginosa*.

1 96. The method of claim 92, wherein the antibody is a monoclonal
2 antibody.

1 97. The method according to claim 92, wherein said antibody is a
2 polyclonal antibody.

1 98. The method of claim 92, wherein the antibody is covalently linked
2 to a detectable moiety.

1 99. The method of claim 98, wherein the antibody is covalently linked
2 to a member selected from a biotin moiety, a radioactive moiety, an enzyme moiety and
3 combinations thereof.

1 100. The method of claim 92, wherein the antibody is bound to a solid
2 substrate.

1 101. A method of isolating an autoinducer, the method comprising the
2 steps of:
3 (a) providing a sample comprising the autoinducer;
4 (b) contacting the sample with an antibody that specifically binds to the
5 autoinducer, thereby forming an autoinducer-antibody complex; and
6 (c) isolating the autoinducer-antibody complex by isolating the antibody.

1 102. The method of claim 101, wherein the antibody is a monoclonal
2 antibody.

1 103. The method of claim 101, wherein the antibody is covalently
2 linked to member selected from a biotin moiety, a radioactive moiety, an enzyme moiety
3 and combinations thereof.

1 104. The method of claim 101, wherein the antibody is bound to a solid
2 substrate.

1 105. A method of detecting an antibody that specifically binds to an
2 autoinducer, the method comprising the steps of:
3 (a) providing a sample;

- 4 (b) contacting the sample with a peptide that specifically binds to the
5 antibody; and
6 (c) detecting the antibody.

1 **106.** The method of claim 105, wherein the step of detecting the
2 antibody comprises an ELISA assay.

1 **107.** The method of claim 105, wherein the peptide is bound to a solid
2 substrate.

1 **108.** A kit for detecting an autoinducer in a sample, the kit comprising:
2 (a) an antibody that binds specifically to the autoinducer;
3 (b) directions for using the antibody to detect the autoinducer.